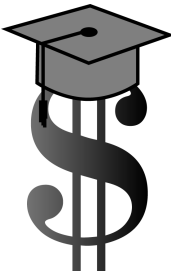


## Section 1.8

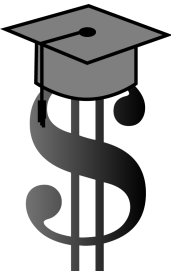
### Exponents and Order of Operations



### What is your degree worth?

In a recent survey, 1250 U.S. college students were asked:  
*“What do you think your starting salary will be at your first job after college?”*

You will use exponents and the order of operations, which are discussed in this section of your textbook, to calculate the percentage of students that anticipated particular income levels.



**First Steps:**

- Take comprehensive notes** from your instructor’s lecture and insert your notes into this section of the *Learning Guide*. Be sure to write down all examples, definitions, and other key concepts. Additional learning resources include the *Lecture Series on DVD*, the *PowerPoints*, and Section 1.8 of your textbook which begins on page 87.
- Complete the *Concept and Vocabulary Check* on page 98 of the textbook.

**Guided Practice:**

- Review each of the following *Solved Problems* and complete each *Pencil Problem*.

<b>Objective #1:</b> Evaluate exponential expressions.	
<p style="text-align: center;"> <b>Solved Problem #1</b></p> <p><b>1a.</b> Evaluate: <math>6^2</math></p> $6^2 = 6 \cdot 6$ $= 36$	<p style="text-align: center;"> <b>Pencil Problem #1</b></p> <p><b>1a.</b> Evaluate: <math>9^2</math></p>
<p><b>1b.</b> Evaluate: <math>(-1)^4</math></p> $(-1)^4 = (-1)(-1)(-1)(-1)$ $= 1$	<p><b>1b.</b> Evaluate: <math>(-4)^3</math></p>
<p><b>1c.</b> Evaluate: <math>-1^4</math></p> $-1^4 = -(1 \cdot 1 \cdot 1 \cdot 1)$ $= -1$	<p><b>1c.</b> Evaluate: <math>(-5)^4</math></p>

**Objective #2:** Simplify algebraic expressions with exponents. **Solved Problem #2****2a.** Simplify, if possible:  $7x^3 + x^3$ 

$$\begin{aligned} 7x^3 + x^3 &= 7x^3 + 1x^3 \\ &= (7+1)x^3 \\ &= 8x^3 \end{aligned}$$

**2b.** Simplify, if possible:  $10x^2 + 8x^3$ 

The terms  $10x^2$  and  $8x^3$  are not like terms because they have different variable factors, namely,  $x^2$  and  $x^3$ .

$10x^2 + 8x^3$  cannot be simplified.

 **Pencil Problem #2** **2a.** Simplify, if possible:  $26x^2 - 27x^2$ **2b.** Simplify, if possible:  $5x^2 + 5x^3$ **Objective #3:** Use the order of operations agreement. **Solved Problem #3****3a.** Simplify:  $20 + 4 \cdot 3 - 17$ 

$$\begin{aligned} 20 + 4 \cdot 3 - 17 &= 20 + 12 - 17 \\ &= 20 + 12 - 17 \\ &= 15 \end{aligned}$$

**3b.** Simplify:  $3 \cdot 2^2$ 

$$\begin{aligned} 3 \cdot 2^2 &= 3 \cdot 4 \\ &= 12 \end{aligned}$$

**3c.** Simplify:  $7^2 - 48 \div 4^2 \cdot 5 - 2$ 

$$\begin{aligned} 7^2 - 48 \div 4^2 \cdot 5 - 2 &= 49 - 48 \div 16 \cdot 5 - 2 \\ &= 49 - 3 \cdot 5 - 2 \\ &= 49 - 15 - 2 \\ &= 34 - 2 \\ &= 32 \end{aligned}$$

 **Pencil Problem #3** **3a.** Simplify:  $7 + 6 \cdot 3$ **3b.** Simplify:  $(4 \cdot 5)^2 - 4 \cdot 5^2$ **3c.** Simplify:  $8^2 - 16 \div 2^2 \cdot 4 - 3$

**3d.** Simplify:  $4[3(6-11)+5]$

$$\begin{aligned} 4[3(6-11)+5] &= 4[3(-5)+5] \\ &= 4[-15+5] \\ &= 4[-10] \\ &= -40 \end{aligned}$$

**3d.** Simplify:  $2[5+2(9-4)]$

**3e.** Simplify:  $25 \div 5 + 3[4 + 2(7-9)^3]$

$$\begin{aligned} 25 \div 5 + 3[4 + 2(7-9)^3] &= 25 \div 5 + 3[4 + 2(-2)^3] \\ &= 25 \div 5 + 3[4 + 2(-8)] \\ &= 25 \div 5 + 3[4 - 16] \\ &= 25 \div 5 + 3[-12] \\ &= 5 + (-36) \\ &= -31 \end{aligned}$$

**3e.** Simplify:  $[7 + 3(2^3 - 1)] \div 21$

**3f.** Simplify:  $\frac{5(4-9)+10 \cdot 3}{2^3-1}$

$$\begin{aligned} \frac{5(4-9)+10 \cdot 3}{2^3-1} &= \frac{5(-5)+10 \cdot 3}{8-1} \\ &= \frac{-25+30}{7} \\ &= \frac{5}{7} \end{aligned}$$

**3f.** Simplify:  $\frac{(-11)(-4)+2(-7)}{7-(-3)}$

**3g.** Evaluate  $-x^2 - 4x$  for  $-5$ .

$$\begin{aligned} -x^2 - 4x &= -(-5)^2 - 4(-5) \\ &= -25 + 20 \\ &= -5 \end{aligned}$$

**3g.** Evaluate  $x^2 + 5x$  for  $x = 3$ .

**Objective #4:** Evaluate mathematical models.**✓ Solved Problem #4**

4. A company that manufactures running shoes has weekly fixed costs of \$300,000 and it costs \$30 to manufacture each pair of running shoes. The average cost per pair of running shoes,  $\bar{C}$ , for the company to manufacture  $x$  pairs per week is modeled by  $\bar{C} = \frac{30x + 300,000}{x}$ .

Find the average cost per pair of running shoes for the company to manufacture 10,000 pairs per week.

$$\begin{aligned}\bar{C} &= \frac{30x + 300,000}{x} \\ \bar{C} &= \frac{30(10,000) + 300,000}{10,000} \\ &= \frac{300,000 + 300,000}{10,000} \\ &= \frac{600,000}{10,000} \\ &= 60\end{aligned}$$

The average cost is \$60.

**✎ Pencil Problem #4 ✎**

4. In Palo Alto, California, a government agency ordered computer-related companies to contribute to a pool of money to clean up underground water supplies. (The companies had stored toxic chemicals in leaking underground containers.) The mathematical model  $C = \frac{200x}{100 - x}$  describes the cost,  $C$ , in tens of thousands of dollars, for removing  $x$  percent of the contaminants. Find the cost, in tens of thousands of dollars, for removing 80% of the contaminants.

**Answers for Pencil Problems (Textbook Exercise references in parentheses):**

- 1a. 81 (1.8 #1)    1b. -64 (1.8 #7)    1c. 625 (1.8 #9)  
 2a.  $-x^2$  (1.8 #21)    2b.  $5x^2 + 5x^3$  cannot be simplified. (1.8 #25)  
 3a. 25 (1.8 #29)    3b. 300 (1.8 #41)    3c. 45 (1.8 #37)    3d. 30 (1.8 #49)  
 3e.  $\frac{4}{3}$  (1.8 #51)    3f. 3 (1.8 #57)    3g. 24 (1.8 #73)    4. \$8,000,000 (1.8 #101b)

**Homework:**

- Review the Section 1.8 summary** on page 107 of the textbook.
- Insert your homework** into this section of the *Learning Guide*. Show all work neatly and check your answers. Strive to work through difficulties when possible, making note of any exercises where you need additional help. Remember, even if your instructor assigns homework through *MyMathLab*, you should still write out your work.